TAXONOMIC ASSESSMENT OF *ASTRAGALUS TEGETARIOIDES* (FABACEAE) AND A NEW RELATED SPECIES FROM NORTHERN CALIFORNIA

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ABSTRACT

Astragalus tegetarioides is taxonomically redefined following recent discoveries of several new sites for this uncommon milkvetch in eastern Oregon. Consequently, disjunct populations previously reported from ash beds in Lassen County, California, are described as the new species **Astragalus anxius**, distinguished by root, inflorescence, pubescence, and floral characters. The morphology, natural history, and putative relationships of the two species are contrasted.

Astragalus tegetarioides M. E. Jones is a local endemic of the northern Great Basin, occupying open pine forests and occasionally sagebrush-juniper steppe. Until recently, the species was poorly known in the field and sparsely represented in herbaria. During the last few years, however, biological inventories associated with federal timber harvest in Oregon have resulted in the discovery of several rather large populations of *A. tegetarioides*. This has renewed taxonomic interest in the species, whose phylogenetic relationships have been considered by Barneby (1964, 1984) to be enigmatic.

Foremost in any reassessment of *Astragalus tegetarioides* is the disposition of an intriguing set of outlying populations reported from northern California. Formerly believed to be a southeast Oregon endemic, *A. tegetarioides* was identified by Nelson and Nelson (1981) from a single locality in Lassen County, California, approximately 325–450 kilometers southwest of the previously known range of the species. The California plants were deemed different in minor ways from Oregon specimens, the main discrepancies being a slightly larger, purplish banner (versus white to lilac-streaked) and longer calyx teeth. Nelson and Nelson (1981) and Barneby (1989) considered these variations to be taxonomically insignificant, although until the last two years very little material of the California or Oregon populations was available for comparison.

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The recent discovery of new populations of *Astragalus tegetarioides* in Oregon has allowed us to clarify the circumscription of the species. In 1990 and 1991 visits were made to all known population centers to re-evaluate the differences previously noted for the California plants, and to determine if these or other traits were outside the range of variation for the species in Oregon. These initial studies strongly suggested that the Lassen County plants are consistently and strikingly dissimilar from those in Oregon. Taxonomically significant variation within the species in Oregon was not evident, as these populations appeared to be morphologically uniform.

To further investigate phenotypic variation in *A. tegetarioides,* seeds from California plants were germinated in a climate-controlled greenhouse and grown together with plants from the three largest Oregon populations. Twenty-six plants (10 from California and 16 from Oregon) were cultivated through early autumn, each developing several inflorescences prior to senescence. The unique characters observed in the field remained constant in the greenhouse, supporting the recognition of the Lassen County, California populations as taxonomically distinct.

In this paper we provide a description for the new species, amend the current description of *Astragalus tegetarioides,* and compare the two species with each other and potentially related taxa.

Astragalus anxius Meinke & Kaye, sp. nov. (Figs. 1, 2)—TYPE: USA, California, Lassen Co., Ash Valley, ca. 25 km west of Madeline and U.S. Hwy. 395, immediately south of Ash Valley Rd., in loose gravel overlying volcanic bedrock, on the boundary of T38N R11E Sect. 32 and T37N R11E Sect. 5, ca. 1550 m, 16 Jul 1991, *Meinke and Lantz 6108* (holotype, OSC; isotypes, CAS, ISC, MO, NY, RM, UC, US).

Herba perennis ± prostrata striguloso-villosula; *radices* diffusae non profundae; *caules* graciles 0.3–2.0 dm longi; *folia* 2.0–5.0(–7.0) cm longa, foliolis 4–6(–7)–jugis (2.5–)4–9(–12) mm longis (1.5–) 2.5–7.0(–10.5) mm latis; *racemi* breves densi floribus (7–)9–13 (–15); *calyx* 3.2–4.7(–5.0) mm longus, dentibus subulatis 1.7–2.7 mm longis; *vexillum* purpurascens vel lilacinum 6.5–10.0(–12.0) mm longum 3.0–5.5(–6.5) mm latum; *alae* albae 4.5–8.8 mm longae; *carina* purpurea 4.7–6.6 mm longa; *legumen* sessile 3.5–4.5 mm longum 3.2–4.2 mm latum angulis lateralibus obtusis valvulis chartaceis strigulosis, ovulis 2–3(–4); *semina* (1–)2–3, 1.7–2.1 mm longa.

Decumbent to weakly prostrate perennial; *stems* slender, trailing, few to many, 0.3–2.0 dm long, freely branching beginning with the lower nodes, arising from a weak, suffruticulose caudex; *roots* diffuse, taproot short with proliferous secondary and tertiary roots, these spreading horizontally in the loose, shallow substrate, with larger

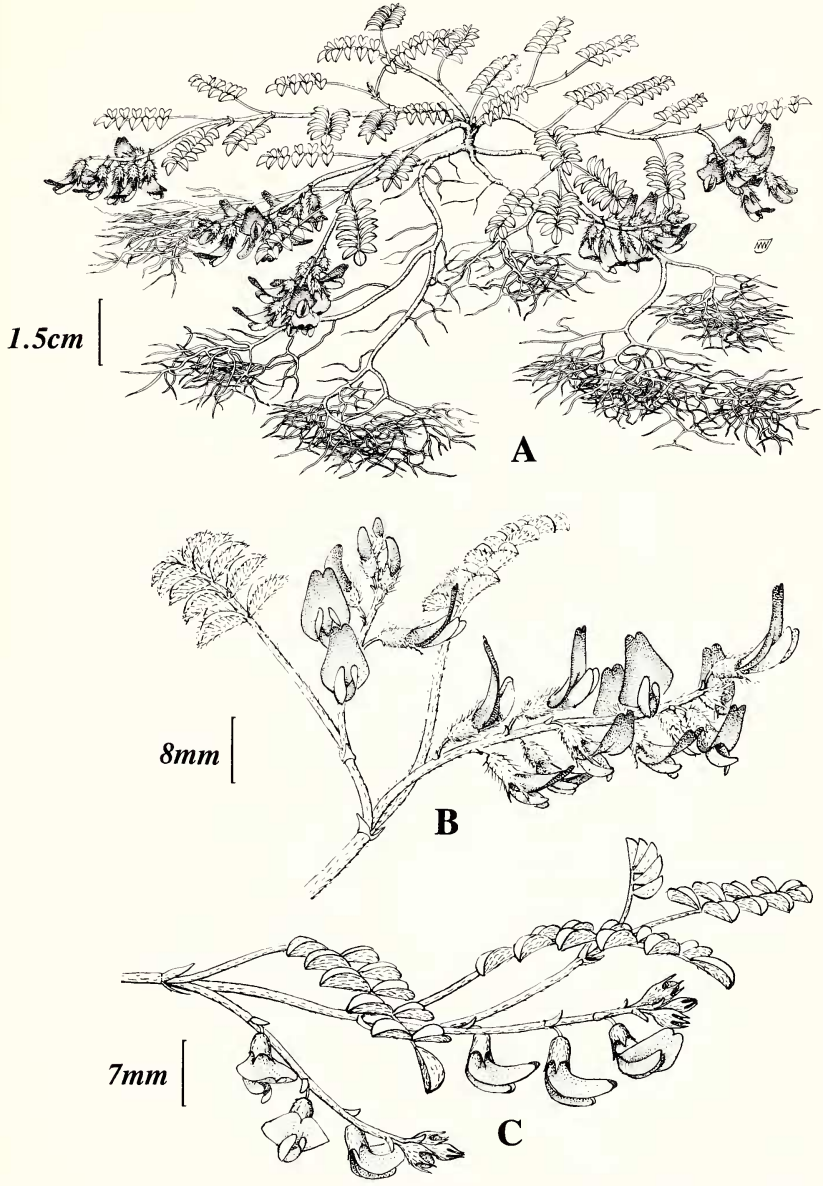

FIG. 1. *Astragalus anxius.* A. Prostrate habit and shallow root masses. B. Close-up of flowering branch. *Astragalus tegetarioides.* C. Close-up of flowering branch.

plants ultimately developing densely branched clusters or mats of pubescent, capillary rootlets up to 10 cm across, possibly with mycorrhizal connections, forming nodules; *pubescence* of short semi-appressed hairs on the lower stems, hoary to subvillous on the new

growth, becoming loosely villous with numerous straight to sinuous hairs up to 1.2 mm long on the stipules, petioles, and particularly the leaflets, the latter pilosulous below and glabrous and green above, occasionally with scattered hairs 1–2 mm inside the dorsal margin; *stipules* 1–4 mm long, thinly herbaceous, becoming papery with age, ovate-acuminate to lanceolate, the blades mostly recurved at the tip, generally completely free but occasionally ± amplexicaul and weakly united by a stipular line at the lowest nodes; *leaves* 2.0–5.0 (–7.0) cm long, with filiform petiole approximately equalling the blade, leaflets crowded, sessile to obscurely petiolulate, 9–13(–15) per leaf, (2.5–)4–9(–12) mm long, (1.5–)2.5–7.0(–10.5) mm wide, flat or partially folded, obovate-cuneate, obtuse to truncate or with a slight apical notch; *peduncles* slender, spreading to erect, 0.5–3.5 cm long, shorter than the leaf; *racemes* congested, 0.8–2.2 cm long in flower, with 0.5–2.0 mm spacing between pedicels, the (7–)9–13 (–15) flowers spreading to ascending, usually declined in post-anthesis; *floral bracts* herbaceous, lance-linear, 1–3 mm long, ciliate; *pedicels* slender, ascending to arcuate, 0.5–1.5 mm long; *calyx* 3.2–4.7 (–5.0) mm long, the tube 1.5–2.2 mm long, pubescence spreading, with straight to wavy hairs 0.7–1.1 mm long, the subulate teeth ciliate, 1.7–2.7 mm long; *corolla* dull lavender in bud, purple and white at anthesis; *banner* rose-purple to deep lilac when fresh, often with darker striations and a pale eye at the base, drying deep violet in well-preserved specimens, narrowly obovate-cuneate, 6.5–10.0(–12.0) mm long, 3.0–5.5(–6.5) mm wide, the blade reflexed 60–80°, notched at the apex, the claw 2.0–3.5 mm long; *wings* white, drying white to faintly lilac, 1.5–3.0 mm shorter than the banner, 4.5–8.8 mm long, ± asymmetric, frequently bent or sigmoidally twisted to the right, the blades narrowly oblong to ligulate, obtuse, 3.8–6.8 mm long, the claws 1.7–2.1 mm long; *keel* pale lilac proximally and dark purple at the tip, 4.7–6.6 mm long, the claws 1.5–2.2 mm long, the oblong blades 3.3–4.4 mm long, incurved ca. 100° at the broad, deltoid apex; *anthers* 0.20–0.30 mm long, pollen orange; *pod* spreading to declined, sessile, dehiscent from the receptacle, uniloculate, lenticulate, 3.5–4.5 mm long, 3.2–4.2 mm wide, plumply ovoid to weakly compressed laterally in cross-section, the papery valves silky-villous, not inflexed, usually glabrescent with age, revealing thin cross-reticulations, beakless or with beak less than 0.5 mm, style persistent, ovules 2–3(–4); *seeds* (1–)2–3, dull black, smooth, 1.7–2.1 mm long.

The epithet "*anxius*" has both passive and active meanings, i.e., troubled or troublesome. Considering the probable correlation between public lands grazing and the long-term prospects for this potentially endangered species, either common name may be appropriate, depending on the point of view.

Paratypes. USA, California, Lassen Co., type locality, 6 Jul 1980, *Nelson and Nelson 5988* (HSC, NY); 29 Jun 1985, *Shelly & King 1028* (OSC); 27 Jun 1990, *Kaye and Meinke 1252* (OSC).

Distribution. Astragalus anxius is believed to be endemic to Ash Valley in extreme north-central Lassen County, California, at 1540–1660 meters elevation. The species is scattered sporadically over a few square kilometers northwest of Spooner Reservoir, occurring on arid flats in or near juniper-sagebrush steppe or *Pinus jeffreyi* woodland. Common associate species include *Artemisia tridentata, Juniperus occidentalis, Eriogonum prociduum, Phacelia hastata, Mentzelia albicaulis, Ipomopsis congesta, Senecio canus, Ivesia paniculata, Ranunculus testiculatus, Alyssum alyssoides, Sisymbrium altissimum,* and *Bromus tectorum.*

Astragalus tegetarioides M. E. Jones, Contrib. West. Bot. 10:66. 1902 (Figs. 1, 2)—TYPE: USA, Oregon, southern Blue Mountains, in sandy soil in the Buck Range, 28 Jun 1901, *Cusick 2619* (holotype, POM!; isotypes, G, GH, K, MO, ND, NY, ORE!, P, RM, US).

Prostrate to matted perennial 0.5–4.0 dm across; *stems* few to many, freely branching throughout, arising from a suffruticose caudex; *taproot* vigorous, elongate, secondary and tertiary roots not prominent, nodules not observed; *pubescence* grayish, ± strigose, the hairs straight to wavy, 0.2–0.6 mm long, appressed-ascending on stems, petioles, and peduncles, the leaflets strigillose, completely pubescent below and medially glabrescent above; *stipules* 1–5 mm long, ovate- to lance-acuminate, the blades recurved at the tip, thinly herbaceous to papery with age, often amplexicaul and united by a stipular line or connate at lower nodes; *leaves* 1.5–4.0(–6.0) cm long, the slender petiole approximately equalling the blade, leaflets loosely arranged, distinctly petiolulate, (5–)7–11 per leaf, 1.5–5.5(–7.0) mm long, obovate-cuneate, obtuse, apically notched or emarginate, seldom conduplicate; *peduncles* slender, ± humistrate, (0.3–)0.6–2.5 cm long, shorter than the leaf; *racemes* loosely (2–)4–6(–8) flowered, 1.3–1.8 cm long, with 1.5–6.0(–8.0) mm spacing between the pedicels, the flowers spreading-ascending, typically declined in fruit; *floral bracts* herbaceous, lanceolate to lance-linear, 1.2–2.7 mm long, pubescence appressed; *pedicels* filiform, spreading to ascending, 0.4–1.3 mm long; *calyx* (2.2–)2.6–3.7 mm long, strigulose, the tube 1.1–2.0 mm long, the teeth subulate, 1.0–1.9 mm long; *corolla* dirty white to olivaceous in bud, whitish to ochroleucous at anthesis; *banner* broadly obovate-cuneate, sometimes lilac-veined, 4.4–5.9 (–7.0) mm long, 3.5–5.1(–6.0) mm wide, the blade reflexed 70–100°, often notched at the apex, the claw 1.0–2.0 mm long; *wings* 4.3–

5.9(–7.2) mm long, ± asymmetric, often bent or twisted to the right, the blades broadly lunate-oblanceolate, obtuse, 3.6–4.1 mm long, the claws 1.1–1.8 long; *keel* 3.3–4.1 mm long, pale- or purplish-tipped, the claws 1.1–1.7 mm long, the broadly lunate blades 2.0–2.5 mm long, the deltoid apex abruptly incurved to 130°; *anthers* 0.2–0.3 mm long, pollen orange; *pod* spreading to declined, sessile, dehiscent from the receptacle, uniloculate, oblong-ovoid to sublenticulate, 3.3–4.5 mm long, 1.5–2.8 mm wide, slightly compressed laterally as seen in cross-section, obscurely dorsiventrally compressed, the valves weakly appressed-pubescent, pale green to somewhat stramineous, not inflexed, becoming generally glabrescent with age, smooth or occasionally with scattered cross-reticulations running vertically between the sutures (as seen under magnification), beakless but usually with the curved style firmly attached, ovules 2–3; *seeds* 1–2, tan to dark brownish or black, smooth, 1.6–2.1 mm long.

Representative specimens. USA, Oregon, Harney Co., yellow-pine slopes 25 mi north of Burns, 15 Jul 1936, *Thompson 13289* (WS, WTU, WILLU!); 18 mi north of Burns, 13 Jul 1938, *Peck 2010* (WILLU!); 2 mi east of Little Juniper Mtn., 21 Jun 1941, *Peck 20853* (WILLU!); open yellow-pine, Malheur National Forest, 18 mi north of Burns along John Day Hwy. (=U.S. 395), 30 Jul 1946, *Maguire and Holmgren 26735* (UTC, WTU); 2.5 mi east-northeast of Little Juniper Mtn., T28S R25E Sect. 7, 30 May 1985, *King 137* (OSC!); along Oregon State Highway Division right-of-way, ca. 29 km north of Burns along U.S. Hwy. 395, T20S R31E Sect. 22, 20 Jun 1991, *Meinke, Lantz, and Clark 6078* (OSC; to be distributed); Dry Mtn., Ochoco National Forest northwest of Riley, T21S R25E Sect. 27, 20 Jun 1991, *Meinke, Lantz, and Clark 6085* (OSC; to be distributed); near the terminus of Smoke Out Canyon, 4.1 km due east of Little Juniper Mtn., T28S R25E Sect. 8, 21 Jun 1991, *Meinke, Lantz, and Clark 6098* (OSC; to be distributed).

Distribution. Astragalus tegetarioides is endemic to northern Harney County, Oregon, at 1500–1630 meters elevation. The species extends irregularly along the extreme southern edge of the Blue Mountains, in the Malheur and Ochoco National Forests. Populations are distributed from near U.S. Hwy. 395 west to the Dry Mountain area near Riley, usually in or near *Pinus ponderosa* woodland. Common associate species include *Artemisia arbuscula, A. tridentata, Purshia tridentata, Allium acuminatum, Calochortus macrocarpus, Ipomopsis aggregata, Mimulus nanus, Collinsia parviflora,* and *Gayophytum diffusum.* An unusual disjunct station, comprised of mostly depauperate individuals, is located near Little Juniper Mountain immediately east of the Lake County line. The population here occurs in a rimrock-scrub community characterized

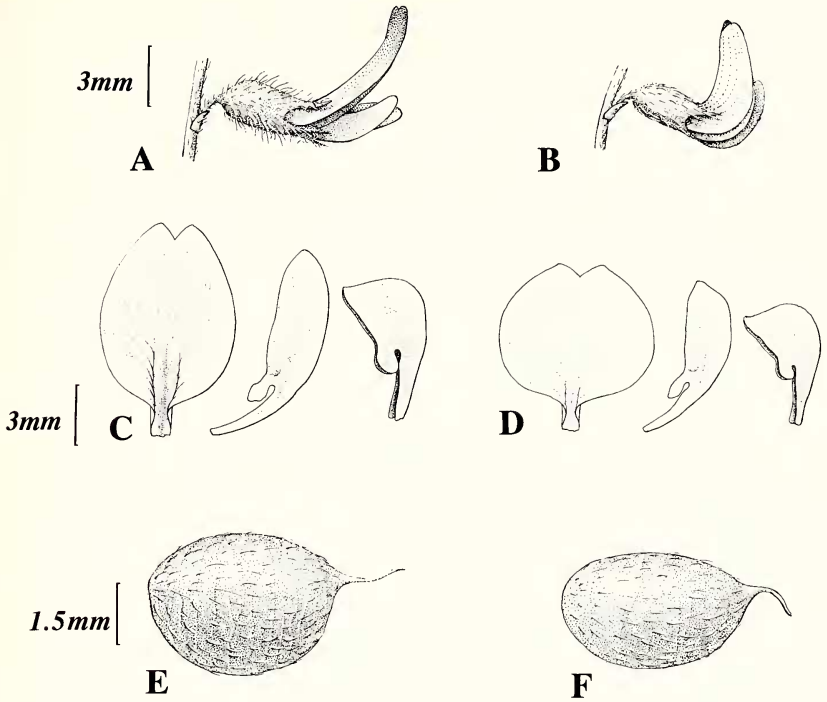

FIG. 2. Comparisons of *Astragalus anxius* (A, C, E) and *Astragalus tegetarioides* (B, D, F). A, B. Flower profile. C, D. Banner, wing, and keel petals. E, F. Pod profile.

by *Juniperus occidentalis, Artemisia tridentata, Chrysothamnus nauseosus, Trifolium gymnocarpum, Astragalus purshii, Lomatium nevadense, Lewisia rediviva, Agropyron spicatum, Poa sandbergii, P. bulbosa, Bromus tectorum,* and *Taeniatherum caput-medusae.*

COMPARISON OF THE SPECIES

Morphology. Salient morphological differences between *Astragalus tegetarioides* and *A. anxius* are summarized in Table 1 and illustrated in Figures 1 and 2. While the two microphyllous species share many traits there are a number of features that separate them, including aspects of root development, floral morphology, inflorescence architecture, and pubescence. Plants of *A. anxius* are typically more robust vegetatively, with larger and more numerous leaflets and a somewhat procumbent (as opposed to strictly prostrate) habit. The new species is also more obviously pubescent, with longer, spreading foliage hairs that are clearly visible to the unaided eye. The longer, bicolored corolla of *A. anxius* is another striking feature, with the combination of rose-purple banner and clear white wings not approached by any populations of *A. tegetarioides.*

TABLE 1. MORPHOLOGICAL DIFFERENCES BETWEEN *ASTRAGALUS ANXIUS* AND *A. TEGETARIOIDES*.

Character	*A. anxius*	*A. tegetarioides*
Root system	weak taproot; secondary roots prolific, spreading	strong central taproot; secondary roots scant
Vegetative pubescence	hairs spreading, evident, conspicuous on underside of leaflet, 0.8–1.2 mm long	hairs inconspicuous and strigillose on leaflets, up to 0.6 mm long
Leaflets	4–9 mm long, scarcely petiolulate; 9–15 per leaf	1.5–5.5 mm long, clearly petiolulate; 7–11 per leaf
Inflorescence	racemes 0.8–2.2 cm long, congested, flowers (7–)9–13(–15)	racemes 1.3–1.8 cm long, loosely arranged, flowers (2–)4–6(–8)
Calyx	3.2–4.7(–5.0) mm long, the teeth spreading-ciliate, 1.7–2.7 mm long	(2.2–)2.6–3.7 mm long, the teeth short-strigose, 1.0–1.9 mm long
Banner petal	rose-purple with a pale basal eye, reflexed 60–80°, narrowly obovate, 6.5–10.0(–12.0) mm long by 3.0–5.5(–6.5) mm wide	whitish, often with pale lilac veins, reflexed up to ca. 100°, broadly obovate, 4.4–5.9(–7.0) mm long by 3.5–5.1 (–6.0) mm wide
Pod	lenticulate, 3.5–4.5 mm long by 3.2–4.2 mm wide, 2–3(–4) ovulate	oblong-ovoid, 3.3–4.5 mm long by 1.5–2.8 mm wide, 2–3-ovulate

Phenology. Both species are primarily summer bloomers, with flowering beginning in early to mid-June and peaking from late June to mid-July. *Astragalus anxius* is largely in fruit by late July, while *A. tegetarioides* may continue to bloom into September or even October, depending on moisture availability.

Reproductive ecology. No fruit developed on plants of either species grown in the greenhouse, although fruits and filled seeds are commonly observed on plants in nature. Anthers in greenhouse plants developed and dehisced normally, and dissections showed that pollen coated the stigmas of both species within 24 hours after anthesis. These observations imply that *Astragalus anxius* and *A. tegetarioides* are incapable of setting seed without pollinators, and are probably self-incompatible. Preliminary field inspection suggests that *A. anxius* receives more insect visitors than *A. tegetarioides,* perhaps due to the showier, more plentiful flowers. Several native bees, primarily species of *Bombus, Osmia, Mellisodes,* and *Lasioglossum,* gather pollen and possibly nectar from *A. anxius* flowers. Insect visitors observed foraging on *A. tegetarioides* flowers are pri-

marily small pollen-gathering bees, including several species of *Lasioglossum* and *Chrysis.* The floral life span for both species averages about three days.

First-year plants of *Astragalus tegetarioides* appear to devote comparatively more resources to vegetative development than to flowering and reproduction. Greenhouse grown plants of both species were cultivated under a spring/summer photoperiod, resulting in an average germination to flowering time of four months for *A. anxius* and six to seven months for *A. tegetarioides.* In addition to producing half again to twice as many flowers per raceme, first year *A. anxius* plants also bloom more prolifically, developing inflorescences at two to three times the rate of *A. tegetarioides.* In the field, large established plants of the two species were observed to produce comparable numbers of inflorescences, although *A. anxius* retained the advantage in flowers per raceme.

Astragalus anxius usually produces two, or occasionally three, seeds per pod, while *A. tegetarioides* often produces only one. Seeds of both species germinate readily after scarification, usually within three days. No pre-dispersal seed predators were observed for either species.

Microsite variation and adaptation. Astragalus anxius and *A. tegetarioides* are found in basin and range plant communities, occurring in volcanic soils associated with openings in the forest or scrub. The substrate occupied by *A. anxius* is unique, however, in consisting of a spongy, ash-gravel aggregate overlying semi-exposed bedrock. The soils here are relatively well-drained, loose, and often only a few centimeters deep. *Astragalus tegetarioides* also occurs in shallow, stony soils, but these tend to be poorly to moderately drained, comprised of ashy clays surmounting heavily fissured bedrock. Populations of *A. tegetarioides* are sometimes found in deeper loams or in crevices of exposed basalt outcrops.

The differences in the root systems of the two species may be related to substrate and microclimatic adaptations. *Astragalus anxius* plants grow from a short taproot and a matrix of secondary and tertiary roots spreading just below the gravelly soil surface. These produce scattered mats of capillary roots, stabilizing the substrate immediately surrounding the plants and presumably facilitating the rapid uptake of water during infrequent spring and summer storms. The emphasis on early flower and fruit production by *Astragalus anxius* may also represent adaptation to periodic drought. *Astragalus tegetarioides,* conversely, has few significant lateral roots but develops a deep taproot capable of penetrating heavy soils and subsurface cracks and fissures. This allows plants access to less ephemeral moisture sources, thereby enabling a longer flowering season and promoting a greater ratio of vegetative to reproductive biomass.

Relationships. The evolutionary relationships of *Astragalus anxius* and *A. tegetarioides* are difficult to assess. Barneby (1964) aligned *A. tegetarioides* with the New Mexico endemic *A. micromerius* (section *Humistrati*), based on fruit and flower size, keel characters, and ovule numbers. He implied that this is a somewhat arbitrary alliance, however, and noted that an affiliation with *A. microcystis* or *A. vexilliflexus* in section *Ervoidei* might be equally appropriate. *Astragalus anxius* is morphologically similar to these taxa as well, particularly *A. microcystis,* a species of northeast Washington to western Montana. Several features of *A. anxius,* including flower number per raceme, leaflet size, pubescence, flower coloration, and pod compression, are more or less intermediate between *A. microcystis* and *A. tegetarioides.*

Barneby (1984) also suggested a relationship between *Astragalus tegetarioides* and the recently discovered *A. tiehmii,* a xerophytic mat-forming perennial from northwestern Nevada. In addition to a microphyllous, prostrate habit, *Astragalus tiehmii* parallels *A. anxius* and *A. tegetarioides* in possessing a tiny, few-seeded pod. It is likewise endemic to ashy substrates, which are comparable, although apparently not identical, to those inhabited by *A. anxius* in Ash Valley (Barneby 1984). *Astragalus anxius* shares a number of traits with *A. tiehmii* that are not found in *A. tegetarioides,* most notably the weak taproot, essentially free stipules, pilosulous foliage, obovate banner, and 3–4-ovulate pods. *Astragalus anxius* differs from both species in its purple flowers, larger banner, more floriferous racemes, pubescence length, and more numerous leaflets. Barneby (1984) speculated that *A. tiehmii* may form an evolutionary connection between *A. tegetarioides* and *A. pulsiferae,* another Great Basin species of uncertain affinities. Further study of *Astragalus anxius* may assist in clarifying the phylogeny of this group.

If *Astragalus anxius* and *A. tegetarioides* are most closely related to each other, there is evidence to suggest that *A. anxius* is the derived member of the pair. *Astragalus tegetarioides* has a broader ecological amplitude, and the discontinuous range of this species indicates it may once have been more plentiful. For example, the disjunct population persisting on rock outcrops near Little Juniper Mountain almost certainly is a relict occurrence, based on the improbability of recent dispersal across 80–100 kilometers of desert to such an ecologically marginal site. *Astragalus anxius* is also isolated from the main range of *A. tegetarioides,* and may represent a modification of that species selected through past climatic changes. Now restricted to a single substrate, *A. anxius* has developed a more specialized, xerophytic life history, exemplified by the diffuse root system, denser pubescence, and precocious reproduction. Although clearly a perennial species, *A. anxius* appears capable of functioning as a facultative

annual, and may routinely flower and set seed the first year. During July field inspections an estimated 98% of *A. anxius* plants, regardless of size, were in flower. Populations of *A. tegetarioides* were far less homogeneous, consisting of reproductive and sterile individuals. Despite numerous leafy branches (in late June) most nonflowering plants were considered prereproductive, defined by the presence of green cotyledons.

Conservation status. All known populations of *Astragalus tegetarioides* are under public ownership, primarily administered by the U.S. Forest Service (USFS) or Bureau of Land Management (BLM). Observations on the Ochoco National Forest show that, in the short term at least, *A. tegetarioides* populations appear to recover from the effects of moderate habitat disturbance associated with timber harvest. Preparations are underway for a demographic study by the USFS to evaluate impacts of logging on the species over several years (A. Kratz, personal communication). In the meantime the agency is protecting the majority of populations. On BLM land domestic overgrazing of *A. tegetarioides* habitat is widespread, evidenced by soil compaction and infestations of pernicious weeds such as *Bromus tectorum* (cheatgrass) and *Taeniatherum caput-medusae* (medusahead wildrye). Data on the effects of grazing and habitat degradation on the biology and demography of *A. tegetarioides* have never been gathered.

Grazing may also be a hazard for *Astragalus anxius,* since all reported sites for this species occur on federal range or privately owned pastures. Impacts from livestock and off-road vehicle use were conspicuous at the type locality in 1991. However, the severity of the substrate appears to be moderating the proliferation of competing exotics that often coincides with such land uses. Trampling by cattle could be the most serious threat to *A. anxius* populations and the unique plant assemblages occurring locally in Ash Valley. Other rarities here include the subshrub *Eriogonum prociduum* and the herbaceous perennial *Ivesia paniculata,* a second narrow endemic.

Another potential effect of habitat disturbance on *Astragalus anxius* and *A. tegetarioides* may be a reduction or elimination of insect pollinators needed for fertilization and seed set. Most of the floral visitors observed foraging on the two species are ground-nesting, and may be particularly sensitive to surface disturbances. Grazing, logging, and pesticide applications can devastate native pollinators, and small populations of either *Astragalus* species could be vulnerable to reproductive failure under these circumstances.

Astragalus tegetarioides is presently a candidate for listing as threatened or endangered under Oregon and federal law. Considering

the current efforts of the Forest Service to conserve and study populations in Oregon, formal listing could ultimately prove unnecessary for this species. *Astragalus anxius,* on the other hand, appears to exist under more precarious circumstances. Its taxonomic separation from *A. tegetarioides* may compel an administrative and biological review, to evaluate the propriety of protecting the new endemic under the federal Endangered Species Act.

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